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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Senthil SENGODAN

Serial No.: 10/017,398

Filed: December 18, 2001

For: METHOD AND APPARATUS FOR
ADDRESS ALLOCATION IN GPRS
NETWORKS THAT FACILITATES
END-TO-END SECURITY

Atty. Docket No.: 005288.00014

Group Art Unit: 2662

Examiner: Nguyen, Hao X.

Confirmation No.: 8170

DECLARATION UNDER 37 C.F.R. § 1.131

U.S. Patent and Trademark Office
Commissioner for Patents

Sir:

I, Senthil Sengodan, hereby declare, unless otherwise excepted, that:

- 1) I am named as the sole inventor of the above-identified patent application;
- 2) I am presently employed by Nokia Corporation (Nokia), and was employed by Nokia during conception and development of the above-identified application.
- 3) Nokia is the assignee of the above-identified application.
- 4) Prior to October 26, 2001, ("the critical date") the actual filing date of U.S. Publ. No. US 2003/0081578 A1, I conceived of the invention recited in the pending claims of the above-identified application.
- 5) Conception is evidenced by the disclosure document entitled "A Method and Apparatus for Address Allocation in GPRS Networks that facilitates end-to-end-security" ("GPRS1") prepared by Senthil Sengodan (dates redacted), a copy which is attached as Exhibit A. This document was prepared prior to the critical date. The date(s) redacted from Exhibit A is/are prior to the critical date.
- 6) The GPRS1 document specifically evidences conception at least of independent claims 1, 8, 20, 28, 31, 32 and 39 at least at pages 4-10, among other places.

- 7) The GPRS1 document was subsequently forwarded to my patent attorney, Mr. Bradley C. Wright of the law firm Banner & Witcoff, Ltd., for preparation of an application.
- 8) On October 18, 2001, my employer forwarded my comments and revisions to a draft application to Mr. Joseph P. Curtin (also an attorney with Banner & Witcoff, Ltd.). The letter communicating the comments and revisions is attached as Exhibit B.
- 9) On October 31, 2001, another draft of the patent application was forwarded to my employer for review. The e-mail forwarding the additional draft is attached as Exhibit C.
- 10) On November 26, 2001, my employer forwarded additional information that I provided on November 21, 2001, to Mr. Wright and Mr. Curtin. The e-mail string communicating the additional information is attached as Exhibit D.
- 11) In response to the comments sent November 26, 2001, Mr. Wright forwarded a fourth draft of the application from Mr. Curtin to my employer for review. We subsequently approved the draft and faxed a signed Declaration and a signed Assignment for filing on December 18, 2001. The fax forwarding the signed documents is attached as Exhibit E.
- 12) On December 18, 2001, the above-captioned patent application was filed in the U.S. Patent and Trademark Office.
- 13) The invention disclosure (Exhibit A) evidences conception, and the preparation and revisions to draft patent applications from a time prior to the Critical Date through the filing of the Application demonstrate diligence from before the Critical Date until the

filings of the above-captioned patent application and the constructive reduction to practice of our invention.

14) All acts referred to in this Declaration were performed either in the United States, or in a WTO member country.

15) The attached Exhibits have not been altered since they were originally submitted to the Patent Committee or otherwise prepared or communicated and any marginalia on the exhibits was contemporaneously written upon receipt of the exhibit in question; and

16) I declare under penalty of perjury under the law of the United States of America that statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

Senthil Sengodan

Senthil Sengodan

December 22, 2005

Date

INVENTION REPORT

Title of invention: A Method and Apparatus for Address Allocation in GPRS Networks that facilitates end-to-end security		INVENTION REPORT RECEIVED Code: _____ Inventor Committee _____	
THE DESCRIPTION OF THE INVENTION MUST BE ATTACHED		Place: _____	Date: _____
		Signature: _____	
Inventor's name, employee number, title and nationality: *) Senthil Sengodan Assistant Research Manager India	Home Address: *) 6 Westgate Dr, #205 Woburn, MA 01803	Business Unit and cost centre:	
Line Manager(s): Raj Bansal			
Project : *)	Project Manager:		
Office address: *) 5 Wayside Road, Burlington, MA 01803, USA			
Phone: *) +1-781-993-3789	Fax: *) +1-781-993-1907		
The invention becomes public on:			
<i>I am/ We are the sole/ and original inventor(s) of this invention.</i>			
<i>The company may, by virtue of applicable legislation, be entitled to full or partial rights to the invention.</i>			
<i>I/ We acknowledge my/ our obligation to sign as inventor(s) all documents that may be required for protecting the invention in different countries.</i>			
Applicable to inventions made by inventors employed in FI, DK, DE and SE only.			
<i>Unless the Inventor requests the Invention Report to be responded to within four (4) months from the date this Invention Report is received or such other period as the mandatory provisions of the applicable local law may otherwise require, the Inventor consents to the right of the employer to use a reasonable period of time for the evaluation of the invention. A reasonable period of time may exceed four (4) months.</i>			
<input checked="" type="checkbox"/> <i>I/ We request that the Invention Report be responded to within four (4) months.</i>			
Date: _____			
Signature(s) of Inventor(s): _____			

*) See the instructions

I have read and understood the invention described in this Invention Report

Date: _____

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INSTRUCTIONS FOR COMPLETING THE INVENTION REPORT

This Invention Report form is used in cases where an invention has been made by an employee of the Company. This Invention Report is confidential. Only the Patent Department may make copies of signed Invention Reports in order to request opinions or reply to the inventor(s).

The inventor completes the Invention Report and the description of the invention. The inventor does not fill in the 'Invention Report received' field. This field is filled in by the Patent Department. The Invention Report must have the names of all the inventors and their home addresses. If there is not enough space for all the names, addresses etc, please write them on a separate attachment. The first mentioned inventor is assumed to be the contact person in matters concerning the Invention Report. In the fields of office address, phone and fax, please fill in the contact person's information. Fill in the project field, if the invention is made in a project. The original Invention Report is signed by all inventors. Each page of the original Invention Report is signed by a Manager. In case it is difficult to obtain Manager's signature your Patent Department will take care of it.

It is suggested that the Invention Report and the description of the invention should be filled in as thoroughly as possible. If drawings or other kind of information cannot be attached to this form, they should be delivered separately.

The signed Invention Report is given directly to the local or business unit's Patent Department. Invention Report should also be sent by E-mail to the Patent Department. The Patent Engineer will inform the inventor of receiving the Invention Report. The Patent Engineer will obtain any expert opinions needed to properly evaluate the invention, will procure the Company's decision and inform the inventor accordingly.

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DESCRIPTION OF THE INVENTION

Please, describe your invention in the following order. You can enclose the drawings on a separate document.

1. Field and background of the invention

NAT and RSIP

IPv4 is the version of IP (Internet Protocol) that is deployed in today's networks – both enterprise networks as well as the public Internet. One of the limitations of IPv4 is its limited address space. In order to conserve addresses, enterprises and other administrative domains have resorted to the use of private addresses. Private addresses are those where the IP address falls in the range: [10.0.0.0 – 10.255.255.255], or [172.16.0.0. – 172.31.255.255], or [192.168.0.0. – 192.168.255.255]. Private addresses that are assigned by an administrative entity within an administrative domain (AD) have relevance only within the AD, and such addresses must not be visible outside the AD. The advantage of this approach is that different ADs may assign the same private IP address to hosts within their respective ADs, without any concern of conflict. When a host that is assigned a private address wishes to communicate with a host that is outside its AD, the use of a Network Address Translator (NAT) is warranted. A NAT transforms the private IP address (and possibly certain other fields) to a public IP address, prior to sending the IP datagram outside its domain.

This approach of using private addresses within ADs, and the use of NATs at the edges of the ADs, has been widely adopted and deployed within enterprises. However, there are two major drawbacks that such an approach faces:

1. Such an approach breaks the end-to-end security model, and
2. Certain applications cannot work in the presence of a NAT, unless remedial measures - such as the inclusion of an application gateway (proxy) - are taken.

Figure 1 illustrates a typical scenario involving NATs.

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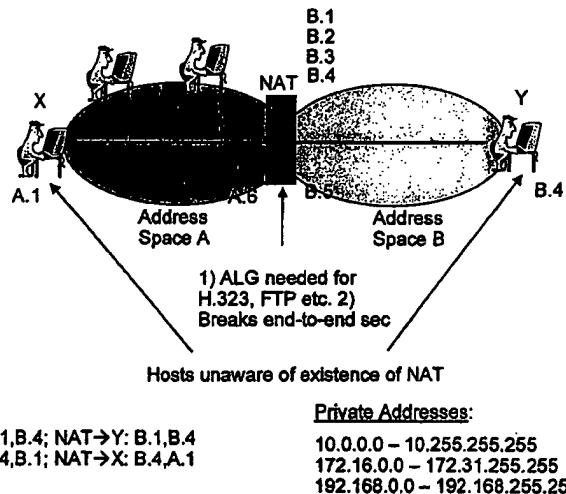


Figure 1: Illustrating NATs

In order to overcome the disadvantages that face NATs, a mechanism termed Realm Specific IP (RSIP). RSIP has been proposed within the IETF and has gained significant support. In RSIP, a host (RSIP client) that needs to be assigned an IP address indicates to the server (RSIP server) that is responsible for assigning IP address, whether the IP address is needed to communicate with hosts within the AD or outside the AD. Based on this information, the RSIP server assigns either a private IP address or a public IP address to the host. It is seen that when a private IP address is assigned to a host, the IP datagram does not leave the AD. When an IP datagram does leave an AD, the address that is assigned to the transmitting host is a public IP address. Thus, the RSIP protocol makes the use of NATs unnecessary, thereby avoiding the drawbacks involving NATs. Figure 2 illustrates the usage of RSIP.

To summarize the discussion thus far, there are generally two broad approaches taken regarding the assignment of IP addresses to hosts within an AD:

1. Assign private addresses to hosts, and when the host needs to communicate with another host that is outside the private domain, make use of Network Address Translators (NATs).
2. Determine whether the host needs to communicate with another host within the same AD or outside the AD, prior to assigning an IP address to it. Assign a private address to a host when it communicates with another host within the same AD. Otherwise, assign a public address to the host. The protocol between the host and the address assigning server is the RSIP protocol.

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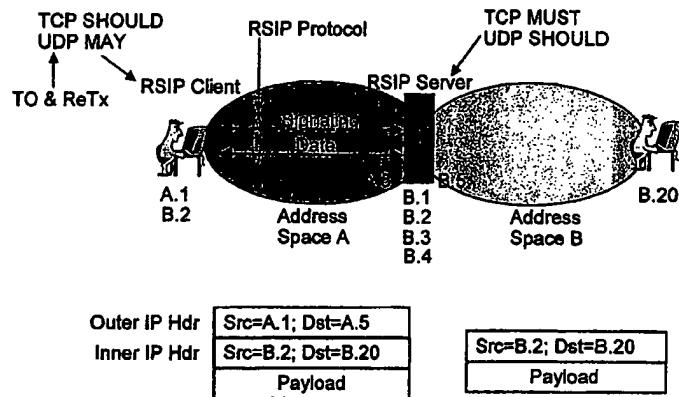


Figure 2: Illustrating RSIP

IP Address Assignment in GPRS Networks

In the case of GPRS networks, a Mobile Station (MS) is assigned an IP address by the General GPRS Support Node (GGSN). Today, such an IP address is an IPv4 address. The protocol that is used for address assignment is specific to GPRS networks, and is termed PDP Context Activation. PDP (Packet Data Protocol) is a term that is used within GPRS networks to refer to IP addresses, X.25 addresses etc. Since we are concerned about IPv4 addresses, the term PDP is synonymous with IPv4 address for this discussion. Figure 3 shows a generic GPRS protocol stack, where the IP address on the MS may be seen. Figure 4 illustrates the PDP context activation procedure within GPRS networks. An Administrative Domain (AD) within GPRS networks (and cellular networks in general) is termed a PLMN (Public Land Mobile Network).

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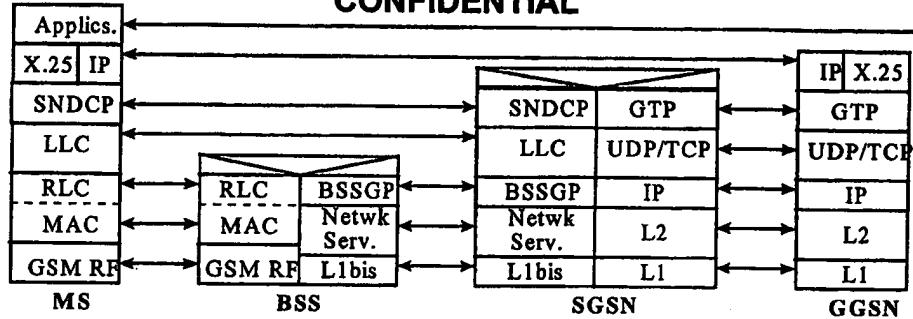


Figure 3: GPRS Protocol Stack

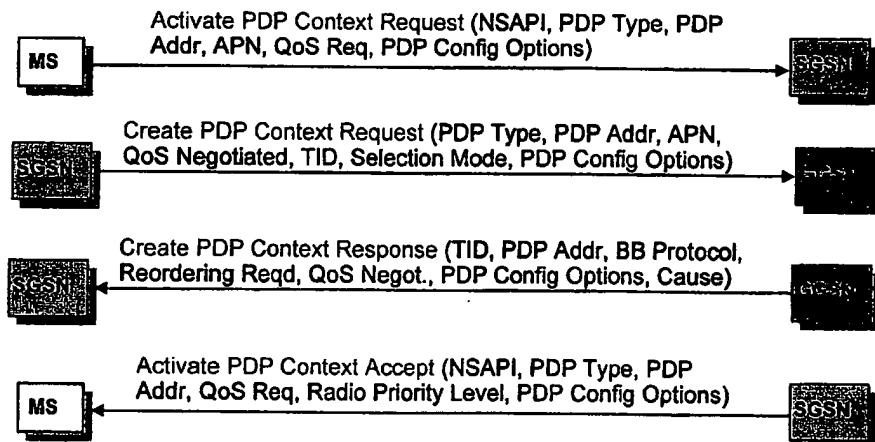


Figure 4: PDP Context Activation

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2. A summary of the invention

When IPv4 addresses are assigned to MSs in a GPRS network, one needs to be concerned about conserving such addresses, while maintaining end-to-end security and application friendliness at the same time. In order to achieve this, this we propose two methods:

1. Use of the RSIP protocol within GPRS networks. We describe the GPRS functional entities where the RSIP client and the RSIP server need to be implemented.
2. Use of the existing GPRS address assignment mechanism (i.e., PDP context activation procedure) with minor modifications, so that a functionality similar to RSIP is achieved. Specifically, we propose the use of the *Access Point Name* (APN) field within the *Activate PDP Context Request* message to convey to the GGSN, whether a private or public IP address needs to be assigned to the MS.

3. Describe the problem which the invention overcomes

The problem that the invention solves is:

- To date, we know of no clear mechanism/procedure for IPv4 address assignment to a MS by a GGSN within GPRS networks, which has the benefits of conserving IPv4 addresses while at the same time maintaining end-to-end security and being application friendly.

4. How was the problem solved earlier?

The GPRS standard itself does not specify whether private or public IP addresses are assigned to MSs, since that is not a standardization issue. It is not a standardization issue when one relies on the fact that NATs will be used at the PLMN boundaries, in the presence of private IP addresses. In other words, I believe that current GPRS deployments rely on the use of NATs at the GGSN when private addresses are assigned to the MSs. While this solves the problem of conserving IPv4 addresses, as we saw earlier, it does not provide end-to-end security or application friendliness.

5. How does the invention improve earlier solutions? Advantages and disadvantages of the invention?

I believe that current GPRS implementations using IPv4 addresses rely on the use of NATs when private addresses are assigned to the MS. The disadvantages of the use of NATs with regard to end-to-end security and application friendliness is known. Consequently, the current solutions suffer from this drawback. The proposed solution(s) avoid this drawback since they are based on the principle of RSIP.

6. Brief description of the drawings (Please enclose drawings and figures of the invention on a separate document)**Drawings Relevant to Proposal 1**

Figure 5 shows the location of the RSIP client and RSIP server functionalities within the GPRS functional elements, so that the RSIP protocol may be used for IPv4 address assignment. As seen in the figure, RSIP client functionality is needed at SGSNs and GGSNs, but is not needed either at the MS or at BGs.

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Similarly, RSIP server functionality is needed at GGSNs and BGs, but is not needed either at the MS or at SGSNs.

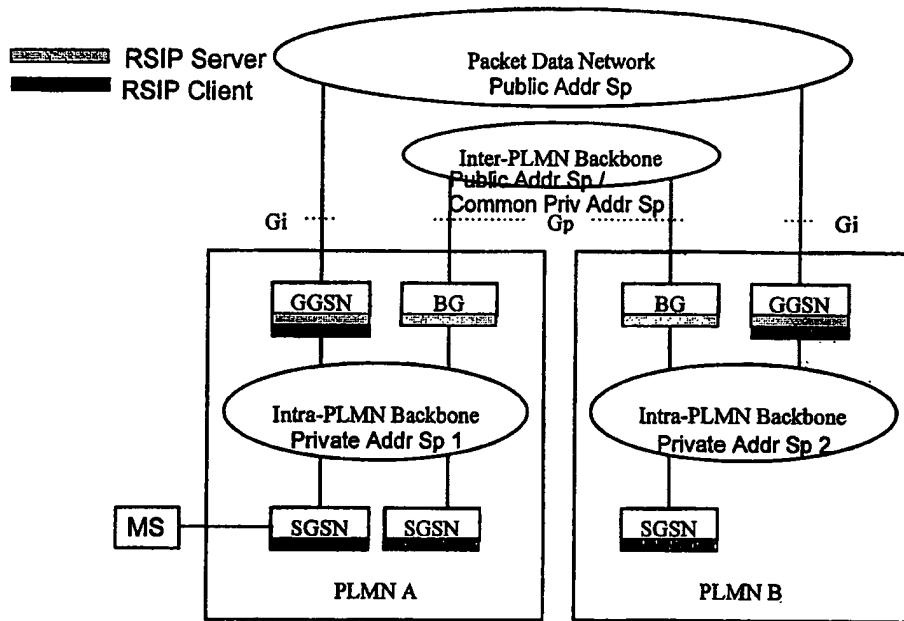


Figure 5: RSIP Client and Server Locations

7. A more detailed description of the invention (if known at the moment)

Detailed Description of Proposal 1

As seen in Figure 4, during PDP context activation (which is the procedure for IPv4 address assignment for the MS), one of the fields in the *Activate PDP Context Request* message sent from the MS to the SGSN is the *Access Point Name (APN)* field. The APN field is used by the MS to indicate a preference of access points or networks for data transfer. The SGSN uses the APN field to choose a suitable GGSN to send the *Create PDP Context Request* message. The *Create PDP Context Request* message sent from the SGSN to the GGSN transparently contains the APN field that was used within the *Activate PDP Context Request* message sent from the MS to the SGSN.

This is illustrated in Figure 5, which shows three GGSNs connected to the Core Network associated with an SGSN. Depending on the value of the APN field in the *Activate PDP Context Request* message sent

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from the MS to the SGSN, the SGSN chooses a suitable GGSN (one of GGSN₁, GGSN₂ or GGSN₃). The *Create PDP Context Request* message is then sent from the SGSN to the chosen GGSN.

Proposal 1 in this document is that the MS indicates its preference of a private or a public address known to the GGSN via the APN field. The GGSN uses this APN field to assign either a private address or a public address to the MS.

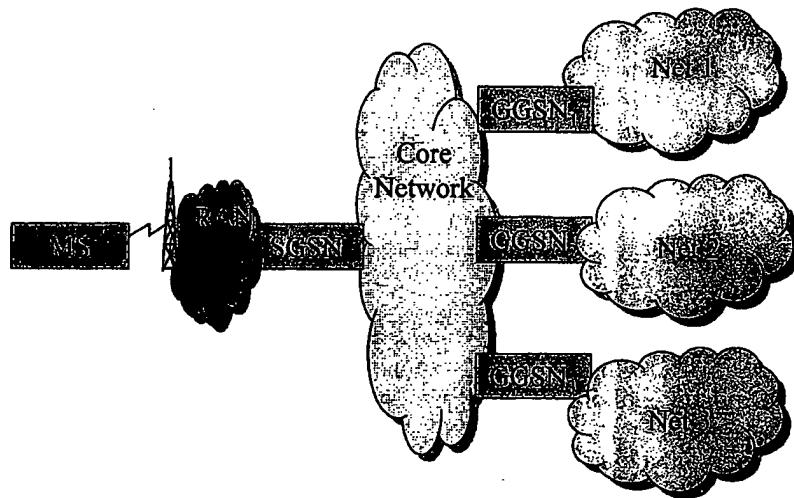


Figure 6: Illustrating the use of APN to choose GGSNs

Detailed Description of Proposal 2

Several scenarios can be discussed to reason out the placement of the RSIP client and server functionalities as shown in Figure 5. Some of these are now discussed.

Scenarios without mobility

Consider the case of the outer IP header between an SGSN and GGSN of the same PLMN, for instance, that in PLMN A of Figure 5. In this case, private addresses can be used always, and hence, for this scenario, we do not need RSIP client or server functionality within any GPRS element.

Consider the case of the outer IP header between an SGSN and GGSN, where the SGSN and GGSN belong to different PLMNs. For instance, consider the case in Figure 5, where the SGSN belongs to PLMN A while the GGSN belongs to PLMN B. In this case, two pairs of RSIP client server functionality come into play: (1) RSIP client at SGSN A and RSIP server at BG A, and (2) RSIP client at GGSN B and RSIP server at BG B.

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For the case of the inner IP header, the RSIP client is at the SGSN while the RSIP server is at the GGSN. This is irrespective of the case whether the GGSN and the SGSN are within the same PLMN or in different PLMNs.

Scenarios with mobility

Consider the case where a MS that is associated with SGSN B moves to a different location that is associated with SGSN A. Let the GGSN be GGSN B, and let us discuss the outer IP header. In this case, two pairs of RSIP client-server functionality come into play: (1) RSIP client at SGSN A and RSIP server at BG A, and (2) RSIP client at GGSN B and RSIP server at BG B. This is identical to the case without mobility since the outer IP header is being discussed.

For this same scenario, let us now discuss the inner IP header. In this case, three pairs of RSIP client/server functionalities come into play: (1) RSIP client at SGSN B and RSIP server at GGSN B (2) RSIP client at GGSN B and RSIP server at BG B, and (3) RSIP client at SGSN A and RSIP server at GGSN A.

Hence, we see that for all the scenarios discussed, the presence of RSIP client and server functionalities as illustrated in Figure 5 serves the purpose.

8. Explain, how the invention is/can be implemented. Which would be the best mode of implementation?

9. Explain how we can recognise if a competitor is using the same product/feature?

10. Is it planned to use the invention in a Nokia product? If so, when and in which product? Is the invention standard related?

11. Abbreviations

AD	Administrative Domain
BG	Border Gateway
GPRS	General Purpose Radio System
IP	Internet Protocol
NAT	Network Address Translator
PDP	Packet Data Protocol
PLMN	Public Land Mobile Network
RSIP	Realm Specific IP
SGSN	Serving GPRS Support Node

12. Any further comments

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A list of references is as follows:

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BANNER & WITCOFF, LTD.

Nokia Inc.
Wayne DeMello
Intellectual Property Rights Dept.
Five Wayside Road
Burlington, MA 01803, USA

This matter is NOT in MDC.
Please advise if we need
to update our database.

MEMO

To:
Joe Curtis

DATE: 10/18/01

TO: ~~Joe Curtis~~
Banner & Witcoff

From: Wayne DeMello
Voice: (781) 993-4636
Fax: (781) 993-1981

RE: Re: more inventor comments on 17391

of Pages: 9

Memo:

Joe,

Please contact Senthil directly with any questions on these comments. Only pages with
Comments are included

Best Regards,

Wayne

Wayne DeMello

|  |  |  |  |  |  |  |  |  |  |*FOR
FILE***From:** Patent-Agency Banner-Witcoff (EXT-RES/Washington)**To:** DeMello Wayne (Nokia-IPR/Boston)**Cc:****Subject:** NC17391 (B&W 5288.00014)**Sent:** 10/31/01 7:12 PM**Importance:** Normal

Mr. DeMello:

Due to an oversight on our part, we believed that we had sent you a third draft of the above application on October 19, 2001. We apologize for the inconvenience and attach a copy of the third draft application and figures for the inventors review.

Many thanks,

Pam Pease
Assistant to Brad Wright
Banner & Witcoff, Ltd.

IMAN_WDC_410538_3.DOC IMAN_WDC_424848_1.PDF

From: Pamela Beth Pease
To: Curtin, Joseph
Date: 11/26/01 3:08PM
Subject: Email from nokia re: 5288.00014 NC17391

Hi Joe:

We just received the below email from nokia. The document can also be found in imange under the client/matter no. Please print this out and place it in the file.

Thanks

From: DeMello Wayne (Nokia-IPR/Boston)
To: Patent-Agency Banner-Witcoff (EXT-RES/Washington)
Cc:

Subject: FW: NC17391 additional material
Sent: 11/26/01 6:08 PM
Importance: Normal
Brad,

Here is additional material from the inventor. Please let me know when to expect the next draft.

BR,
Wayne

—Original Message—

From: Sengodan Senthil (NRC/Boston)
Sent: Wednesday, November 21, 2001 5:48 PM
To: DeMello Wayne (Nokia-IPR/Boston)
Subject: NC17391 additional material

Hello Wayne,

GPRSAddr-mod.doc

I promised to provide Joe Curtin some additional material on NC17391. I've included the original paper that I had forwarded with some additional material included within that. Specifically, two illustrations have been added for Proposal 1 under Section 4. These illustrate the functioning of one of the approaches proposed in the invention, and the reasoning behind the placement of the RSIP client and server functionality at certain network entities (like SGSN, GGSN and BG). Please pass it on to Joe. Thanks & hope you have a good thanksgiving holiday!

- Senthil

CC: Wright, Bradley



Fax

To:	Joe Curtin / Banner & Witcoff	From:	Patricia Griffin
Fax:	202-508-9299	Pages:	5 Including Cover Page
Phone:	202-508-9155	Date:	12/18/2001
Re:	NC 17391 Declaration and Assignment	CC:	
<input checked="" type="checkbox"/> Urgent <input type="checkbox"/> For Review <input type="checkbox"/> Please Comment <input type="checkbox"/> Please Reply <input type="checkbox"/> Please Recycle			

• **Comments:**

Hi Joe,

Faxing over the signed Declaration and Assignment for NC 17391, please file this today.

Thank you,

Pat

Patricia Griffin
Patent Assistant to Nokia House Boston
5 Wayside Road
Burlington, Massachusetts 01821
781-993-3822 Office
781-993-1981 Fax
781-910-6206 Mobile
patricia.griffin@nokia.com

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